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BIENVENIDO MARIA GONZALEZ [1]

In the last Eighth Pacific Science Congress, an American delegate, Dr. Albert O. Rhoad, geneticist of the King's Ranch in Texas, opened his discussion on animal production with a significant remark. He said that the idea which led to the creation of the now world-famous Santa Gertrudis breed of cattle at the King's Ranch had been inspired by research publications of Filipino scientists. It will be recalled that as early as the 1920's Mr. Gonzalez, then a young instructor in animal husbandry at the College of Agriculture, recognized the fact that standard breeds of farm animals, all of which are of temperate-country extraction, are ill-adapted to the warm and humid tropical environment. He, therefore, set vigorously to work and, despite meager facilities, launched a program at Los Baños to create our own superior animal breeds based on locally better-fitted, although relatively inferior, parentage. It should be pointed out that in the Philippines almost no other animal husbandman took kindly to Doctor Gonzalez's premise, except his co-workers in Los Baños. Although his was virtually the lone voice in the wilderness, he clung to his idea with almost fanatical zeal. Doctor Gonzalez was too ill to attend the Science Congress and he was therefore spared having had to come violently face to face with the ironic situation where Texas, which gave respectful attention to his message, has reaped rich rewards, while his own country, which he had meant to benefit from his efforts but which had turned a deaf ear, has received surprisingly little.

The foregoing incident is detailed here to describe what to my mind is the most outstanding attribute of the man—his resoluteness of purpose. To his problems he brought a great deal of careful planning and thought and a meticulous attention to details. His was the sharply analytical mind and scientific attitude that enabled him to make quick decisions. That he had a keen mentality has been attested to by his former classmates and later associates. When he was a graduate student at the University of Wisconsin, his major professor, the head of the Department of Animal Husbandry, informed President Van Hise that Gonzalez was one of the two best students in the history of his department. At Los Baños, he was one of the earlier products of the old six-year Bachelor of Agriculture curriculum, which was based on intermediate school graduation. His undergraduate preparation was, therefore, wanting in the broad cul-

[1] General Contribution No. 868. Oration delivered at the necrological services in memory of the late Dr. Bienvenido Maria Gonzalez, under the auspices of the University of the Philippines and the National Research Council of the Philippines, Wednesday afternoon, February 3, 1954, College of Liberal Arts Building, U. P., Quezon City.

[THE PHILIPPINE AGRICULTURIST, Vol. 37, No. 8, January, 1954, appeared in November, 1954.]
THE PHILIPPINE AGRICULTURIST, VOL. 37, NO. 9, FEBRUARY, 1954

tural foundation which nowadays is deemed essential in all college courses. Realizing his initial handicap, Gonzalez imposed upon himself the task of rounding up his education. Through diligent self-study, he soon became a match for any one who had had the advantages of a full liberal arts training. He was a man with the courage of his convictions; he was never a sycophant in questions of principles. He abhorred mediocrity. With his flair for facing issues squarely, he detested a weak-kneed solution to the problem at hand. This uncompromising attitude and the force of his argumentation earned for him, early in his undergraduate days, the nickname, "Majority of One," and, despite his very considerable ability, did not help win for him popular support for the student body presidency. It was this same idealism and unflinching stand on questions which made for him bitter enemies when at 25 he was an alumni member of the Board of Regents. It was also this attitude that almost precipitated a students' strike and resignation of part of the faculty when he was appointed Dean of the College of Agriculture. And it was this attitude which later cost him the presidency of the University. But it was also this attitude, this passion for high standards and absolute loyalty to service, which, under his deanship, made the College of Agriculture a strong college and the University of the Philippines, under his presidency, a great university where he built up at such great pains an atmosphere of academic freedom and scholarship. Perhaps few other men would have dared reopen the University amidst the rubble left by the last war and, later, undertake the appalling task of translocating the institution to the then almost barren expanse of Diliman.

That President Gonzalez had the reputation of being a strict disciplinarian is understandable. For himself and his beloved family, he set up rigid ethical norms and lived by them. Uncompromising with himself, he thus instinctively took for granted in others the same attitude toward life. It is true he could be harsh, abrupt, and difficult on occasions, but even at such times one could not but be impressed by his sincerity and personal integrity. Never was he known to back out on his word or shield himself behind some hapless colleague or subordinate as a means of self-preservation. President Gonzalez could also be a man of wide sympathies. Many a successful graduate of the College of Agriculture doubtless would not have finished his studies had not Doctor Gonzalez, while dean, anonymously helped him financially through faculty intermediaries. When for any reason a faculty member or employee had to be dropped from the payroll, he suffered and worried perhaps as much as the victim himself. And, when President Gonzalez died, it was a signal tribute to his greatness as a man and a loyal public servant, a distinguished scientist and a dynamic administrator, that many came to mourn him. It was a mourning heavy with the sense of personal loss yet lightened by the thought that over men such as he Death can not truly have full claim.

LEOPOLDO B. UICHANCO
Dean, College of Agriculture

ON THE NATURAL OCCURRENCE OF TWO CRYSTALLINE FORMS OF VANILLIN [1]

AURORA T. VIOLANDA

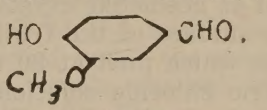
WITH THREE TEXT FIGURES

Two different crystal forms of vanillin were found on the vanilla pods: needles and tetragonals. The two forms gave different melting points and reactions under polarized light, but showed similarities in such properties as odor, solubility, and reaction with ferric chloride. When recrystallized from ether or alcohol both forms gave rise to crystals possessing identical forms, melting points, and reactions under polarized light. It appeared that these crystals were not calcium oxalate.

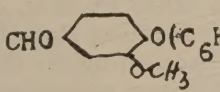
David [2] stated that properly cured vanilla pods produce vanillin crystals on their surface. These vanillin crystals are technically known as "givre," and their presence has universally been taken to be the criterion of quality of good vanilla pods.[3]

Recently, however, doubt has arisen regarding the identity of the crystals on the pods. It is recorded by several authors, including Leach [4] and Blumenthal,[5] that the vanilla bean contains calcium oxalate as one of its constituents. The question therefore arises as to what the real nature is of the crystals that form on the vanilla pods. Are some of them calcium oxalate crystals? If they are, then one cannot judge the quality of the beans by the amount of crystals that form on the pods, which has always been thought to be the criterion of quality.

According to Karrer [6] vanillin is an aldehyde which is widespread in nature, but mostly in small quantities. It is obtained as methyl vanillin, with the structural formula



Methyl vanillin is naturally present in the vanilla bean partly in the form of a glucoside, gluco-vanillin, with the formula



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[1] Central Experiment Station Contribution No. 1747. Prepared in the Department of Agricultural Chemistry and read before the Los Baños Biological Club, March 26, 1954.

[2] Pedro A. David, *Philippine Agriculturist*, 33, 239 (1950).

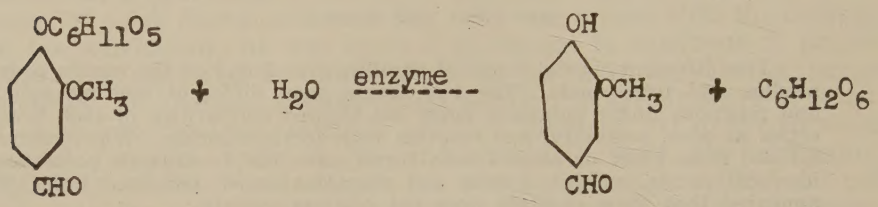
[3] Encyclopedia Britannica, U.S.A., 1947, Vol. 22, p. 977.

[4] Albert E. Leach, "Food Inspection and Analysis," John Wiley and Sons, Inc., N. Y., 1941, pp. 911-912.

[5] Saul Blumenthal, "Food Products," Chem. Publishing Co., Inc., Brooklyn, N. Y., 1947, pp. 53-54.

[6] Paul Karrer, "Organic Chemistry," translated from the latest German edition by A. J. Mee, Elsevier Publishing Co., N. Y., 1938, p. 467.

In the curing of mature beans the glucoside is broken down or hydrolyzed to vanillin and glucose by the action of an enzyme as follows:



glucovanillin vanillin glucose

Arana [7] explained that the enzyme involved is of the nature of beta-glucosidase.

Vanilla beans contain from 1 to 4 per cent vanillin.[8] This substance begins to appear in the form of crystals on the surface of the blossom end of the pods during the conditioning period and eventually covers about two-thirds of the surface of the beans. The blossom end of the pods is more mature than the other parts, and crystallization occurs there because the material from which vanillin is formed is present in larger quantities and the enzyme beta-glucosidase that does the work is probably more active in that region.

Blumenthal [9] described the vanillin crystals that form on the pod as needlelike crystals that stand out almost at right angles from the surface of the fruit. Karrer [10] described them as colorless needles which melt at 80 to 81°C., boil at 170°C. (15 mm.), and color ferric chloride solution blue. Leach [11] stated that vanillin is best examined when crystallized from ether solution by allowing the ether to evaporate spontaneously from the slide. Under optimum conditions vanillin crystallizes from ether in long, slender needles, often radiating from central points or forming star-shaped bundles. These crystals are optically active. According to the same authors pure vanillin, under polarized light, gives a brilliant interplay of colors between crossed nicols even without the selenite plate.

This study was undertaken in the Department of Agricultural Chemistry from June, 1953, to March, 1954, to find out if calcium oxalate crystals are present on the cured vanilla pods together with the vanillin crystals.

---

[7] Francisco E. Arana, *Puerto Rico (Mayaquez) Fed. Exper. Sta. Cir. No. 25*, 2 (1945).
[8] *Ibid.*
[9] Blumental, *op. cit.*
[10] Karrer, *op. cit.*
[11] Leach, *op. cit.*

METHODS OF STUDY AND RESULTS

Cured vanilla pods with crystals formed on them were obtained from Dr. P. A. David of the Department of Agronomy. The crystals on the vanilla beans were examined, and the different crystal forms were picked out and separated with a pair of forceps. Only two kinds of crystals were found: needles and tetragonals.

Properties of the crystals

Odor. Both crystal forms were found to give the same characteristic smell of vanilla.

Reaction with ferric chloride. Samples of the two crystal forms were dissolved by slight heating in water. The resulting solutions were treated with ferric chloride solution. Both samples colored the ferric chloride solution blue.

Solubility. Portions of each of the two crystal forms were tested for their solubility in alcohol, ether, and water. Both crystal forms were completely soluble in ether and alcohol, slightly soluble in cold water, and moderately soluble in hot water.

Melting point. The melting points of the naturally occurring crystals and the recrystallized forms were determined by the capillary method, with plain tap water as the bath. Among the naturally occurring forms, the needles gave a melting point range of 77 to 79°C., whereas the tetragonals gave a melting point range of 81 to 82°C. All the recrystallized forms of crystals gave the same melting point range, 77 to 79°C.

Observation of the crystals under the microscope

Kinds of crystal forms. Samples of each of the two crystal forms were mounted on a glass slide and studied under the microscope. Photomicrographs were taken. The results showed two kinds of crystal forms—tetragonals and needles (fig. 1).

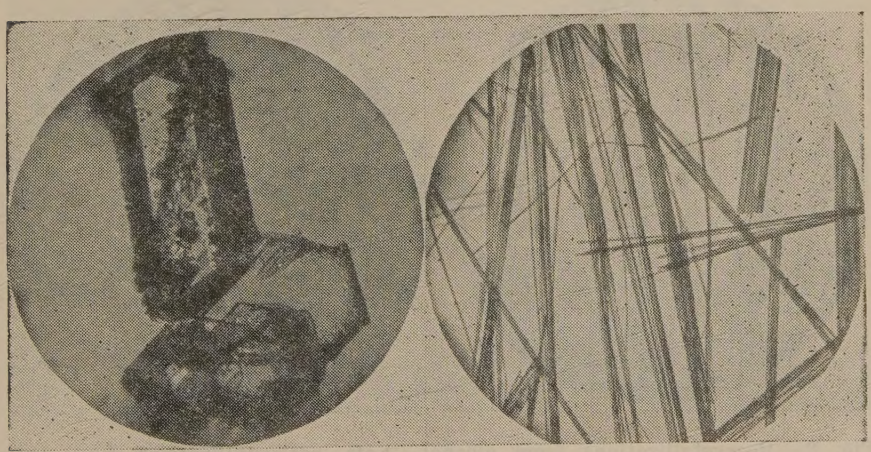


Fig. 1.—Naturally occurring crystals. Left, tetragonal crystals; right, needle-like crystals.

Recrystallizations. A few crystals of the two forms were picked out and placed on separate glass slides. Two drops of either ether or alcohol were added to each slide in order to dissolve the crystals. The solvent was allowed to evaporate spontaneously in the air. The recrystallized forms were again studied under the microscope and photomicrographed.

The tetragonal crystals recrystallized from ether produced needlelike crystals, and the needles also produced needlelike crystals similar to those formed from the tetragonals (fig. 2). The tetragonal crystals recrystallized from alcohol gave needlelike crystals, and the needles also gave needlelike crystals (fig. 3).

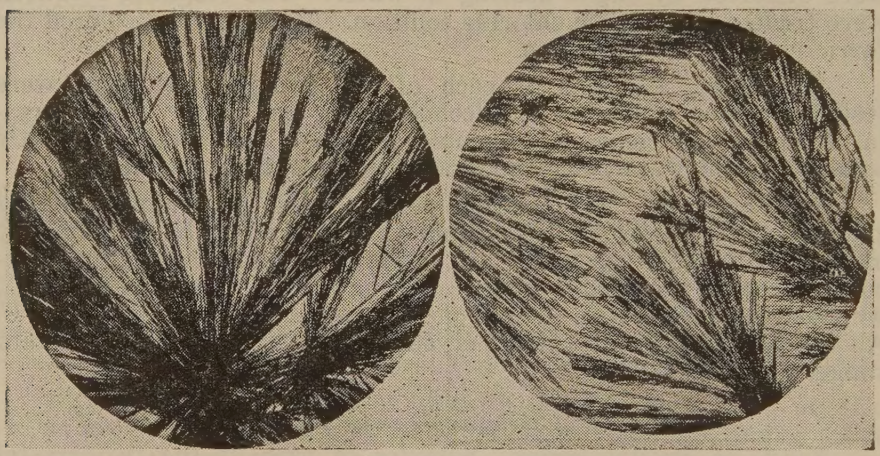


Fig. 2.—Recrystallizations from ether. Left, recrystallizations from the tetragonal crystals; right, recrystallizations from the needlelike crystals.

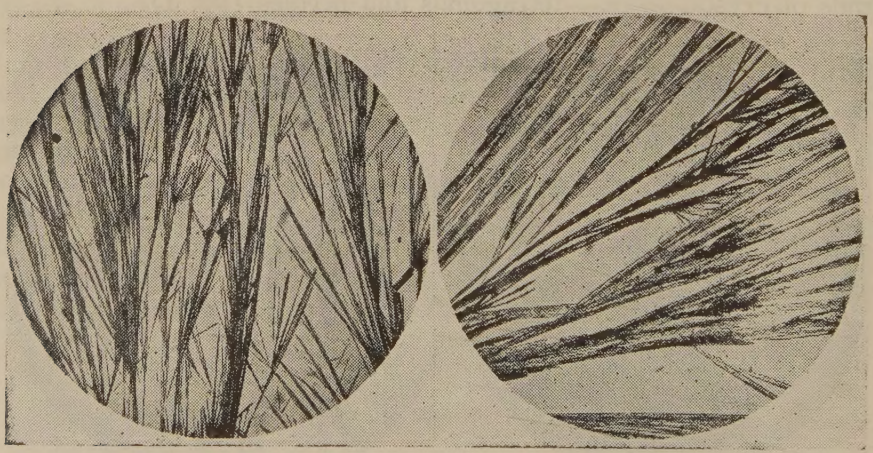


Fig. 3.—Recrystallizations from alcohol. Left, recrystallizations from the tetragonal crystals; right, recrystallizations from the needlelike crystals.

Observation of the crystals under polarized light

Samples of each of the two naturally occurring forms and their recrystallized forms were studied and compared under polarized light.

The tetragonals of the naturally occurring crystals gave no interplay of colors, but the needles gave a brilliant interplay of colors. The recrystallized forms of both the tetragonals and the needles from ether and alcohol solvents gave brilliant interplays of colors under polarized light.

CONCLUSION

It appears that the naturally occurring crystals in vanilla pods possessing the odor of vanilla occur in two forms: needles and tetragonals. They seem to be of the same chemical compound because the tetragonal crystals change to needles by recrystallization from ether and ethyl alcohol and because, although they may have different melting points, when recrystallized the tetragonals and the needles give identical melting points. Since calcium oxalate is not soluble in ether or in ethyl alcohol, these vanilla crystals are not likely to be calcium oxalate.

THE EFFECT OF PENICILLIN UPON THE GROWTH OF BERKJALA PIGS [1]

CEFERINO O. OLIVO

Pigs fed the 1.5-gram penicillin ration showed a significant gain in weight over the 1.0-gram and zero-gram penicillin lots during the first three months of feeding. Penicillin evidently tends to restrict the growth of nutrient-destroying bacteria and at the same time promote the development of nutrient-synthesizing bacteria, both of which actions influence considerably the growth rate of pigs.

The 1.0-gram penicillin lot consumed the greatest amount of feed to produce a given unit of gain for the entire 252-day test, and the 1.5-gram penicillin lot required the least. As for the cost of feed to produce a kilogram gain, the addition of 1.5 grams of penicillin to 100 kilograms of feed mixture resulted in a saving of eleven centavos daily during the first three months of feeding.

Studies in the United States have shown that penicillin, when included in a well-balanced ration, increases the growth rate of growing and fattening pigs.

Heidebrecht, Ross, Whitehair, and MacVicar (1951) reported that penicillin, when added to a ration composed of ground yellow corn, expeller soybean meal, alfalfa meal, trace mineralized salts, steamed bone meal, and vitamin D supplements, tended to increase the rate of growth and efficiency of feed utilization of pigs raised in the Oklahoma Agricultural Experiment Station.

Dyer, Harrison, Nicholson, Jr., and Cullison (1952) added penicillin to the ration at the rate of 2.27 milligrams per pound and attained significant improvement in the rate of gain and condition of pigs.

Beeson (1951) observed that pigs fed 5 milligrams procaine penicillin for every pound of feed gave maximum growth response and feeding efficiency.

On the other hand, Norris (1951) stated that feeding antibiotics to animals does not promote growth by a direct effect upon the body metabolism, but that it indirectly increases the absorption of the relatively insoluble mineral elements by reducing the pH value of the content of the lower part of the intestinal tract. He also opined that antibiotics restrict the growth of bacteria which tend to destroy the essential nutrients, or compete with the animal for them, and at the same time promote the development of bacteria which are able to synthesize essential nutrients needed for growth. These findings were also obtained by Wahlstron and his associates (1952).

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[1] Central Experiment Station Contribution No. 1748. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Animal Husbandry under the direction of Dr. Faustino S. Mensalvas and Mr. Avelino B. Manuel.

In another experiment, Bridges, Dyer, and Power (1953) observed that when penicillin combined with streptomycin was added to a basal ration for pigs, the rate of gain in weight was significantly increased, but when penicillin alone was added to the basal ration, no significant result was obtained.

To determine the effect of penicillin upon the growth of Berkjala pigs raised in Los Baños and to determine further the amount of penicillin necessary to produce the most satisfactory results, this study was conducted in the Department of Animal Husbandry, College of Agriculture, from March 21 to November 28, 1953, a period of 252 days.

MATERIALS AND METHODS

Twelve Berkjala weanling pigs (six barrows and six females) were grouped at random into three lots according to weight, age, and sex. The pigs were fed individually in separate pens with adjoining runs.

The rations given the three lots during the whole 36-week period of the experiment were as follows:

FEEDING PERIOD	LOT I (CONTROL)	LOT II	LOT III
First 12 weeks	College ration No. 2	College ration No. 2 plus 1.0 gram penicillin per 100 kg. feed	College ration No. 2 plus 1.5 grams penicillin per 100 kg. feed
Second 12 weeks	College ration No. 3	College ration No. 3 plus 1.0 gram penicillin per 100 kg. feed	College ration No. 3 plus 1.5 grams penicillin per 100 kg. feed
Third 12 weeks	College ration No. 4	College ration No. 4 plus 1.0 gram penicillin per 100 kg. feed	College ration No. 4 plus 1.5 grams penicillin per 100 kg. feed

The ingredients of the College rations, all parts by weight, are as follows:

	NO. 2	NO. 3	NO. 4
Fine rice bran	60	60	60
Ground corn	15	20	25
Copra meal	18	16	13
Fish meal	7	4	2
Mineral mixture[a]	2	2	2
Total	102	102	102

[a] Composed of 2 parts ground shells and 1 part common table salt.

The pigs were hand-fed twice a day, once in the morning, from 7:00 to 8:00 o'clock, and once in the afternoon, from 3:00 to 4:00 o'clock. They were allowed to eat as much feed as they could readily

consume in about thirty minutes of feeding. The feed consumed the first week served as the basis for estimating the amount of the ration prepared for the next week. Throughout the experiment, each pig in the three lots was given 2 per cent soilage every day at noon. Water was made available at all times. Before the pigs were put in their respective pens, they were first treated with phenothiazine to eliminate parasite worms. Practically the same care and feeding was given to all the pigs.

The pigs were weighed weekly from the start to the end of the experiment. The initial and final weights of each pig were the averages of two consecutive weighings. The pigs were bathed and allowed to dry off before they were weighed. The weekly feed consumption of every animal, as well as the monthly cost of each feed, was also recorded.

DISCUSSION OF RESULTS

In the discussion of the results of the present study, lots I, II, and III will be referred to as the zero-gram penicillin lot, 1.0-gram penicillin lot, and 1.5-gram penicillin lot, respectively. The results obtained were based on the following criteria: (1) daily rate of gain, (2) amount of feed in kilograms to produce a kilogram gain, and (3) cost of feed in pesos [2] to produce a kilogram gain. The results from the zero-gram penicillin lot, or the control, were used as the basis for comparing the results obtained from the other two lots.

First 84-day period, or the growing period. In the first 84-day feeding, lot III pigs on 1.5-gram penicillin ration gained most rapidly (table 1). Lot II pigs on 1.0-gram penicillin ration gained as rapidly as lot I pigs on zero-gram penicillin ration. The difference in rate of gain between the 1.5-gram penicillin lot and the zero-gram penicillin lot is significant (table 2a). It is interesting to note that although the average initial weight of lot II, the treated lot, was lower than that of lot I, the untreated lot, the average final weight of lot II was slightly higher than that of lot I.

As regards the amount of feed consumed to produce a kilogram gain in weight, the figures in table 1 show that the addition of penicillin to the rations of lots III and II did not cause any increase in the feed consumption of the pigs. The amounts consumed by lots III and II were even less than that consumed by the untreated lot. Lot III pigs on 1.5-gram penicillin ration consumed the least, lot II pigs on 1.0-gram penicillin ration was second, and lot I pigs on zero-gram penicillin ration consumed the most. On the basis of feed cost for every kilogram gain in weight, the 1.5-gram penicillin lot appeared to be the most economical, the zero-gram penicillin lot the second, and the 1.0-gram penicillin lot the least economical.

Second 84-day period, or the growth-fattening period. In the second 84-day period, the control lot showed an unusual increase in

[2] The feed mixture cost seventeen centavos a kilogram; penicillin, sixty centavos a vial containing 0.5 gram.

weight, whereas the two penicillin-treated lots were somewhat stationary (table 1). This clearly indicates that penicillin no longer had much advantageous effect after the first feeding period. Judged by the amount of feed to produce a kilogram gain, the 1.5-gram penicillin lot consumed the least feed and the 1.0-gram penicillin lot, the most. As regards the cost of feed to produce a kilogram gain, the zero-gram penicillin lot was the least expensive, and the 1.0-gram penicillin, the most expensive.

Third 84-day period, or the fattening period. In the third 84-day period, the average daily rate of gain in weight was highest for lot I pigs on zero-gram penicillin ration and lowest for lot II pigs on 1.0-gram penicillin ration (table 1). The untreated lot consumed the least feed to produce one kilogram gain in weight, and the treated lots consumed the most. For the zero-gram penicillin lot the cost of feed to produce one kilogram gain was lowest, and for the 1.0-gram penicillin lot, it was highest.

The entire 252-day test. The results obtained for the entire feeding experiment of 252 days show that in rate of gain and conversion of feed into gain in weight, the 1.5-gram penicillin ration was the best, followed by the zero-gram penicillin ration and the 1.0-gram penicillin ration (table 1). Lot I on zero-gram penicillin ration would have shown a much lower rate of gain in weight than the other two lots were it not for the exceptional increases in weekly weight exhibited by pig number 1460 in this lot. For some unknown reason this animal made exceedingly high gains in weight ranging from three to four kilograms weekly from the middle up to the end of the second 84-day feeding period.

These findings on the advantageous effect of the 1.5-gram penicillin ration agree with those of Heidebrecht, Ross, Whitehair, and MacVicar (1951) who found the optimum level of penicillin added to a well-balanced ration for growing pigs to be 0.75 gram per 100 pounds of the ration, or about 1.6 kilograms per 100 kilograms of feed. When treated statistically, however, the differences among the three lots with respect to rate of gain were insignificant (table 2b). To detect small differences, adequate control should be used to reduce experimental error.

During the entire 252-day test, lots I and III used up about the same amount of feed to obtain a kilogram gain in weight. Lot II consumed a bigger amount. Regarding the cost of feed consumed to produce a kilogram gain, lot I was slightly economical, lot III was next, and lot II was the most expensive.

During the entire feeding test the animals were generally in good condition. The pigs on 1.5-gram penicillin ration and 1.0-gram penicillin ration were more uniform in size and weight than the pigs on zero-gram penicillin ration. In the middle of the first 84-day period, the pigs in both lots II and III (penicillin-treated lots) were observed to possess very fine hair and reddish-brown skins. Their skins were glossy and pliable, indicating that these animals were in

excellent condition. These characteristics gradually disappeared by the middle of the second 84-day period. The pigs in lot I, however, continued to have coarse hair and did not show any marked change in condition of skin. At about the end of the first 84-day period, two of the animals in lot I got sick. One was able to recover and made normal gains in weight up to the end of the experiment, but the other animal died. A post-mortem examination pointed to kidney worm. *Stephanurus dentatus,* as the cause of death. No pig died or had any apparent pathological disturbances in both lots II and III.

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TABLE 1

Summary of results

	FIRST 84-DAY FEEDING PERIOD			SECOND 84-DAY FEEDING PERIOD			THIRD 84-DAY FEEDING PERIOD			ENTIRE 252-DAY FEEDING PERIOD		
	I	II	III	I	II	III	I	II	III	I	II	III
Number of pigs	4	4	4	3	4	4	3	4	4	3	4	4
Duration of experiment, days	84	84	84	84	84	84	84	84	84	252	252	252
Average initial weight of a pig, kg.	9.15	8.30	9.00	30.07[a]	29.00	35.90	56.27	49.15	60.80	9.15	8.30	9.00
Average final weight of a pig, kg.	27.20	29.00	35.90	56.27	49.15	60.80	83.13	72.05	85.70	83.13	72.05	85.70
Total gain in weight, kg.	72.0	82.80	105.60	78.60	80.60	99.60	80.58	91.60	99.60	221.94	255.00	306.80
Total feed consumed, kg.	274.0	295.0	305.40	364.00	439.80	475.00	475.00	644.00	629.00	1,048.60	1,378.80	1,391.80
Average gain in weight of a pig, kg.	18.05	20.70	26.90[b]	26.20	20.15	24.90	26.86	22.90	24.90	73.93	63.75	76.70
Average feed consumed by a pig, kg.	68.50	73.75	76.35	121.33	109.95	114.35	158.33	161.00	157.25	349.53	344.70	347.95
Average daily gain in weight of a pig, kg.	0.22	0.25	0.32	0.31	0.24	0.30	0.32	0.27	0.30	0.29	0.25	0.30
Daily feed consumed per 100 kg. live weight, per cent	4.48	4.71	4.05	3.34	3.34	2.82	2.70	3.16	2.56	3.12	3.38	2.92
Feed consumed per kilogram gain, kg.	3.79	3.56	2.84	4.63	5.46	4.59	5.89	7.03	6.32	4.80	5.41	4.54
Feed cost per kilogram gain, pesos	0.64	0.65	0.53	0.79	1.00	0.86	1.00	1.28	1.18	0.82	0.98	0.85

[a] Based on three pigs.
[b] Significant at 5% probability level.

TABLE 2a

Gain in weight in kilograms of the pigs during the first 84-day period

BLOCK	LOT I	LOT II	LOT III
1	20.2	19.2	24.4
2	13.0	23.4	23.0
3	22.6	22.6	30.8
4	16.4	17.6	29.4
Sum	72.2	82.8	107.6
Mean	18.05	20.70	26.90

Analysis of variance

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F-VALUE		
				Computed	Tabular	
					5%	1%
Block (B)	3	51.56	17.19			
Treatment (T)	2	165.05	82.53	7.32	5.14	10.92
B × T	6	67.67	11.28			
Total	11	284.28	25.84			

L.S.M.D. = 5.80

TABLE 2b

Gain in weight in kilograms of the pigs during the entire 252-day period

BLOCK	LOT I	LOT II	LOT III
1	67.8	66.8	70.2
2	73.3 [a]	69.2	72.0
3	89.2	59.6	83.4
4	61.4	59.4	81.2
Sum	291.7	255.0	306.8
Mean	72.93	63.75	76.70

[a] Missing data.

Analysis of variance

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F-VALUE		
				Computed	Tabular	
					5%	1%
Block (B)	3	186.19	62.06			
Treatment (T)	2	354.85	177.43	2.0045	5.79	13.27
B × T	5	442.54	88.51			
Total	10	983.58	98.36			

THE DIGESTIBILITY BY RUMINANTS OF PARA GRASS (PANICUM PURPURASCENS RADDI), CULAPÉ (PASPALUM CONJUGATUM BERG.), GUATEMALA GRASS (TRIPSACUM LAXUM NASH.), AND CORN SILAGE [1]

J. K. Loosli,[2] V. Villegas, G. V. Garcia, and L. A. Ynalvez [3]

WITH ONE TEXT FIGURE

The digestible protein of para grass ranged from 2.8 to 11.7 per cent, and the total digestible nutrients from 35.5 to 71.8 per cent, expressed on a moisture-free basis, depending upon the stage of maturity of the grass. Culapé contained 7.0 per cent of digestible protein, as against 3.0 per cent for Guatemala grass and 1.3 per cent for corn silage. The last two feeds were similar in total digestible nutrient content; both contained 56.9 to 61.6 per cent on a dry basis.

In 1933 Taleon, Villegas, and Manahan-Ylagan [4] studied the digestibility of flint corn silage by carabaos. Villegas,[5] in 1953, estimated the digestible proteins and total digestible nutrient contents of many of the feeds available in the Philippines on the basis of chemical analyses and Morrison's [6] digestion coefficients for similar feeds. However, no recent research has been conducted in the Philippines to determine the nutritive value of the various feeds, a knowledge of which is essential to successful livestock production. Studies on the digestibility by ruminants of para grass (*Panicum purpurascens* Raddi), culapé (*Paspalum conjugatum* Berg.), Guatemala grass (*Tripsacum laxum* Nash.), and corn silage were therefore thought timely.

EXPERIMENTAL WORK

Sheep and goats were used in the studies because they were easy to handle and had smaller feed requirements, which made it less expensive to provide a uniform supply of pure stands of the forage crops for them. The data regarding the rations are given in table 1, and those pertaining to the animals are summarized in table 2.

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[1] Central Experiment Station Contribution No. 1749.

[2] Visiting professor of animal husbandry from Cornell University.

[3] The authors gratefully acknowledge the assistance of Misses Lolita Austria and Epifania Cruz in making the chemical analyses and of Messrs. S. E. Claud and A. Palacpac in feeding the experimental animals and preparing the samples for chemical analyses.

[4] A. T. Taleon, V. Villegas, and M. Manahan-Ylagan, *Philippine Agriculturist*, 22, 13 (1933).

[5] Valente Villegas, *Nat. Res. Council Bull. No. 35* (1953).

[6] F. B. Morrison, "Feeds and Feeding," Morrison Publishing Co., Ithaca, New York, 1951.

The animals were removed from pasture and placed in digestion cages (fig. 1) designed to separate the feces and urine. They were fed para grass and a concentrate mixture for approximately one month to accustom them to confinement and to being handled. After the feed intakes had been standardized the animals were fed constant

Fig. 1.—One of the metabolism cages used in the digestion experiments.

amounts of feed for two weeks before the feces were collected. Collections were made for 7 to 10 days. The feces were weighed and carefully mixed at the same hour each day. Ten per cent of each of the feces was dried under an infrared lamp so it could be pulverized composited, and stored in a sealed Mason jar without spoiling until the chemical analysis was made. At each feeding during the collection period a sample of the forage was dried for determination of the moisture content. The samples were composited and saved for analyses. The same procedure was followed for any orts (feed refuse) that were obtained.

The studies on culapé, corn silage, and Guatemala grass employed the same pattern used on para grass.

Four separate experiments involving a total of 21 trials and seven sheep and two goats were carried out using para grass. Experiment 1 was conducted within six weeks after the five sheep had been removed from pasture. Following the collection periods, fecal examinations revealed mild to moderate infestations of stomach worms (*Haemonchus contortus*), stomach flukes (*Cotylophoron cotylophorum*), and coccidia oocysts.[7] The animals were treated with phenothiazine (5 to 20 grams according to body weight). No evidence of fecal parasites was detected two weeks after treatment. Experiment 8 was then conducted to measure any possible change in the digestion coefficients as a result of the treatment.

From four to seven animals were used with each of the other feeds. In all studies the feed intakes were limited to minimize feed refuse. The small amounts of orts occasionally obtained were analyzed and considered in the calculations.

RESULTS AND DISCUSSION

The composition of each of the forages and concentrate mixtures studied is given in table 3. The average digestion coefficients with standard errors for the feeds are presented in table 4. In experiments 1 and 8 with para grass and in experiment 15 with corn silage, a concentrate mixture was fed along with the roughage. For estimating the digestibility of the roughages alone, the average digestion coefficients for the concentrates reported by Schneider [8] were used to correct for the fecal residues from the concentrates, permitting calculation of the coefficients for the roughages by the usual difference method. Both types of values are shown in table 4.

When the effects of the concentrates were discounted, the digestion coefficients of the para grass and corn silage in experiments 1 and 15 became lower, as was expected. In experiment 8 this was not the case, suggesting that the protein, crude fiber, and nitrogen-free extract of this para grass was fully as digestible as the nutrients in the concentrate mixture. The lots of para grass used in experi-

[7] Identification of the intestinal parasites was made by Dr. J. D. Generoso of the Bureau of Animal Industry, Manila.

[8] B. H. Schneider, "Feeds of the World," West Virginia Experiment Station, Morgantown, West Virginia, 1947.

ments 1 and 8 both averaged 46 centimeters in height and were green, succulent, and leafy. The very high total digestible nutrient values of the grasses (table 5) confirm the view that they are approximately equal to concentrates in feeding value. It will be noted in table 4 that except for organic matter and protein the digestion coefficients following treatment for parasites (experiment 8) were not significantly greater than those before treatment (experiment 1). The differences may have resulted from the differences in the grasses fed.

The lots of para grass studied in experiments 14 and 23 were more mature and much less leafy and succulent. The lot studied in experiment 23 was left standing until well into the dry season. It averaged 90 centimeters in height when cut and fed as soilage. The grass had lodged and many of the lower leaves had died. The growing tips were green and leafy and no heads had formed although other grasses in the same area had matured and produced seeds. It is evident from the digestion coefficients (table 4) that as the para grass became older and more mature the digestibility of all the nutrients decreased markedly.

The corn silage was less digestible than the immature para grass, but it was significantly better than the most mature para grass, except in digestibility of protein. The lower coefficient of the protein of corn silage was expected because, on a moisture-free basis, the silage contained only 5.9 per cent protein compared with 8.9 for the mature para grass, and it is known that the metabolic fecal nitrogen depresses the apparent digestibility of the protein of feeds that are low in protein content.

The values for culapé and Guatemala grass were similar to those for corn silage and the para grass studied in experiment 14. Culapé was more palatable to sheep than Guatemala grass. The sheep tended to refuse to eat the coarse stems and the midribs of the leaves of Guatemala grass unless the feed intakes were restricted.

Except with ether extract and protein of corn silage, the results among animals in a given trial were very uniform. The low ether-extract content of the roughages studied and the excretion of metabolic fecal fat explain the variability and minimize the practical importance of the variation.

Morrison's [9] average digestion coefficients for para grass are 56, 62, 56, and 61 for protein, ether extract, fiber, and nitrogen-free extract, respectively. These values correspond most closely to the medium stage of maturity of the para grass used in experiment 14. Morrison's average values for flint corn silage are appreciably higher than those for protein in the present study, but are similar to those for the other nutrients. Guatemala grass and culapé have not been studied previously.

Comparison of the digestible proteins and total digestible nutrient contents of the roughages is most accurate on the moisture-

[9] Morrison, *op. cit.*

free basis. The decrease in the digestible protein and total digestible nutrients of para grass with advancing maturity is very striking (table 5). These data emphasize the importance of keeping grasses grazed or clipped so that growing, succulent plants, rather than a rank and overmature crop, are available to the animals. The culapé was a good sources of digestible protein, much superior to corn silage or Guatemala grass, but it was no better as a source of energy.

These studies were carried out with sheep and goats when the results would have been more valuable if cattle and carabaos had been used since there are more of these animals in the Philippines. In the present experiments the digestion coefficients obtained for goats were almost identical with the values for sheep. A study was also made of the published digestion coefficients to learn whether there are important differences in the digestive efficiencies of cattle, sheep, and goats. Morrison averaged the coefficients for ruminants in arriving at his values for total digestible nutrients and digestible protein of feeds. Goats have not been used extensively in digestion trials, and for this reason only eleven feeds (four concentrates and seven roughages) were found for which there were digestion coefficients for all three species with feeds having similar descriptions and chemical analyses. None of the differences among cattle, sheep, and goats (table 6) was statistically significant at ₱.05 probability.

These comparisons can be interpreted as favoring the view that digestion coefficients obtained with sheep or goats can be applied to cattle with reasonable confidence. They should not be taken as final proof that these species digest all feeds to a similar degree because it has been shown that cattle utilize corn cobs and certain other bulky feeds better than sheep. At any rate, it seems reasonable to assume that the digestion coefficients reported for sheep and goats are also applicable to cattle. Whether carabaos digest feed to a greater extent than cattle has not been determined.

TABLE 1

Number of animals and rations used in the different experiments

EXPERIMENT NO.	RATION	NO. OF ANIMALS	DATE COMPLETED
1	Para grass and concentrates	5 sheep	9–10–53
8	Para grass and concentrates	5 sheep	11–17–53
14	Para grass alone	2 sheep, 2 goats	12–20–53
23	Para grass alone	7 sheep	1–6–54
15	Corn silage and concentrates	5 sheep	1–6–54
19	Culapé alone	4 sheep	2–22–54
21	Guatemala grass alone	4 sheep	3–9–54

TABLE 2

Data regarding animals used in digestion trials

HERD NO.	SPECIES	SEX	DATE OF BIRTH	INITIAL BODY WEIGHT
				kg.
43	Sheep	Male	May 29, 1949	38.5
45	"	"	June 14, 1949	38.3
188	"	Wether	March 12, 1953	11.2
190	"	"	March 23, 1953	10.7
191	"	"	March 25, 1953	15.6
194	"	"	April 29, 1953	9.3
197	"	"	May 2, 1953	10.7
161	Goat	Male	December 20, 1951	15.4
165	"	"	December 17, 1951	17.1

TABLE 3

Chemical composition of feeds used in the experiments [a]

EXPER. NO.	FEED	MOISTURE	CRUDE PROTEIN	ETHER EXTRACT	CRUDE FIBER	N-FREE EXTRACT	ASH
		per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
1	Para grass, 45 cm. tall	66.3	3.9	1.3	10.0	14.2	4.3
8	Para grass, 45 cm. tall	85.5	2.1	0.4	4.2	5.9	1.9
1 & 8	Concentrate mixture [b]	6.4	16.9	11.9	4.4	55.3	5.1
14	Para grass, 90 cm. tall	77.7	2.0	0.5	7.5	9.5	2.8
23	Para grass, 100 cm. tall	79.5	1.8	0.3	6.5	9.7	2.2
15	Corn silage, few ears	74.0	1.5	1.0	8.6	12.6	2.3
15	Concentrate mixture [c]	16.9	9.9	3.4	4.8	58.8	6.2
19	Culapé, 25 cm. tall	81.0	2.0	0.3	5.8	8.4	2.4
21	Guatemala grass, 120 cm. tall	74.7	1.5	0.5	9.1	12.0	2.2

[a] The analyses were made according to the A.O.A.C. methods. Nitrogen was analyzed according to a semimicro modification designed by L. A. Ynalvez.

[b] Contained 32% Yellow Flint corn, 33% copra meal, 33% fine rice bran, 1% shells, and 1% salt.

[c] Contained 25% Yellow Flint corn, 25% copra meal, 25% fine rice bran, 23% cane molasses, 1% shells, and 1% salt.

TABLE 4

Average digestion coefficients

EXPER. NO.	FEED	ORGANIC MATTER	CRUDE PROTEIN	ETHER EXTRACT	CRUDE FIBER	N-FREE EXTRACT	NO. OF TRIALS
1	Para grass plus concentrates	79.0 ± 0.96[a]	75.4 ± 1.02	79.4 ± 2.60	81.9 ± 1.50	76.3 ± 1.60	5
1	Para grass[b]	77.9 ± 1.34	73.5 ± 2.19	54.2 ± 8.60	77.5 ± 1.70	79.8 ± 2.46	5
8	Para grass plus concentrates	80.2 ± 0.59	80.2 ± 0.36	76.6 ± 0.91	75.3 ± 0.67	83.4 ± 0.01	5
8	Para grass[b]	81.0 ± 0.70	81.1 ± 1.23	51.3 ± 6.10	77.7 ± 1.38	83.7 ± 0.93	5
14	Para grass	53.2 ± 0.73	53.9 ± 1.06	20.9 ± 5.10	56.9 ± 0.94	51.0 ± 1.13	4
23	Para grass	38.3 ± 2.62	48.4 ± 1.47	23.0 ± 5.60	40.9 ± 3.65	37.1 ± 3.68	7
15	Corn silage plus concentrates	66.0 ± 2.05	49.1 ± 5.45	66.2 ± 5.92	42.8 ± 3.97	74.7 ± 1.26	5
15	Corn silage[b]	62.2 ± 2.68	22.5 ± 7.25	78.8 ± 4.09	56.2 ± 1.78	83.4 ± 1.35	5
19	Culapé	69.1 ± 1.85	64.7 ± 2.07	45.2 ± 9.2	63.4 ± 5.26	66.2 ± 5.08	4
21	Guatemala grass	60.3 ± 2.86	51.8 ± 2.53	62.3 ± 4.61	60.7 ± 3.07	61.2 ± 2.84	4

[a] Means ± standard error.
[b] Calculated by difference for the roughage alone.

TABLE 5

Digestible proteins and total digestible nutrient contents of the forages on fresh and dry bases

EXPERIMENT NO.	FORAGE	FRESH BASIS		MOISTURE-FREE BASIS	
		Digestible protein	Total digestible nutrients [a]	Digestible protein	Total digestible nutrients
		per cent	*per cent*	*per cent*	*per cent*
1	Para grass	2.9	13.5	8.6	70.2
8	Para grass	1.7	10.4	11.7	71.8
14	Para grass	1.1	12.4	4.8	46.9
23	Para grass	0.9	7.4	2.8	35.5
15	Corn silage	0.3	16.1	1.3	61.6
19	Sulapé	1.3	9.7	7.0	59.6
21	Guatemala grass	0.8	14.4	3 0	56.9

[a] Total digestible nutrients equal the sum of the digestible protein, the digestible ether extract × 2.25, the digestible crude fiber, and the digestible nitrogen-free extract.

TABLE 6

Digestion coefficients for cattle, sheep, and goats

SPECIES	CRUDE PROTEIN	ORGANIC MATTER	CRUDE FIBER	N-FREE EXTRACT	ETHER EXTRACT
Cattle	67	70	58	74	54
Sheep	70	69	59	74	52
Goats	72	69	54	71	53

NODULATION AMONG THE LEGUMINOSAE [1]

LEONARDO L. BAÑADOS AND WILLIAM L. FERNANDEZ

Only *Cassia mimosoides* L., *Cassia occidentalis* L., and *Hymenaea courbaril* L. of the examined species of Caesalpinioideae showed nodulation. The percentage of nodulation in the subfamily Mimosoideae ranged from 60 to 100. Three species did not show nodules: *Parkia javanica* (Lam.) Merr., *Calliandra inaequilatera* Rusby, and *Adenanthera intermedia* Merr. All the examined species of Papilionatae showed a high percentage of nodulation, except *Gliricidia sepium* (Jacq.) Steud. The highest percentage of nodulation occurred among the vines and herbaceous plants.

It is a common concept that all leguminous plants in symbiosis with the root nodule bacteria form nodules in their root systems. A number of workers have observed, however, that certain leguminous plants do not have nodules. Leonard [2] noted the absence of nodules in the Caesalpinioideae. Allen and Allen [3] also observed that many exceptions occur in the Caesalpinioideae.

The absence of root nodules may be attributed to the absence of the right rhizobia in the soil, to the prohibitive properties of the host plant, or to the lack of adaptability of the plant. A survey of this phenomenon in the Philippines will contribute to the ecological studies on nodulation among the Leguminosae. This survey was therefore conducted from December, 1952, to March, 1954, in the Central Experiment Station, Los Baños, Laguna, and in Calamba, Laguna, to determine the extent of nodulation among the leguminous plants and trees in those places.

MATERIALS AND METHODS

Root systems of leguminous plants and trees were examined in the field. Plant parts were taken to the laboratory and identified.[4] No attempt was made to determine quantitatively the number of nodules to a plant. Examination for the presence or absence of nodules in the big trees was made by carefully removing the soil from a portion of the root mass. Whenever seedlings of trees were available, the entire root systems of the plants were dug to permit a more adequate examination. The root systems of vines, herbs, and shrubs, such as the species of *Desmodium, Indigofera, Glycine, Lourea, Psophocarpus, Phaseolus, Uraria, Vigna, Tephrosia, Pueraria,*

[1] Central Experiment Station Contribution No. 1750. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Plant Pathology under the direction of the junior author.

[2] L. T. Leonard, *Soil Sci.*, 20, 165 (1925). Cited in *Soil Sci.*, 42, 87 (1936).

[3] O. N. Allen and E. K. Allen, *Soil Sci.*, 42, 87 (1936).

[4] Identification was made by Mr. Juan V. Pancho of the Department of Agricultural Botany.

and *Abrus,* were dug entirely from the soil. Stained bacterial smears were made from the nodules of each species. The smears were examined under the oil-immersion objective for the presence of bacteria or other microorganisms. The percentage of the presence or absence of nodules for each species was calculated.

RESULTS AND DISCUSSION

Of the 28 species of the subfamily Caesalpinioideae examined, only three species had nodules; namely, *Cassia mimosoides* L., *Cassia occidentalis* L., and *Hymenaea courbaril* L. (table 1). All 10 plants of *Cassia mimosoides* L. had numerous small, round, and smooth-surfaced nodules distributed throughout their entire root systems. Only one of the 20 *Cassia occidentalis* L. plants was nodulated. It bore only one nodule. Ten of the 15 *Hymenaea courbaril* L. plants had large, light-brown, rough-surfaced nodules.

Nobbe, Schmid, Hiltner, and Hotter [5] were among the first to suggest that the physical character of the root hairs of several species of the subfamily Caesalpinioideae inhibited nodule formation. McDougal [6] expressed the same opinion as a result of his work on the thick-walled root hairs of the genus *Gleditsia* and related genera. Joshi [7] proposed the idea that root nodule bacteria might exist in the root tissues of certain leguminous plants and not form root nodules. A lower virulence of the specific bacteria or a slower reaction of the plant to the stimulus given by the bacteria was offered as an explanation for the lack of typical nodule formation.

Of the subfamily Mimosoideae, 12 species were examined (table 1). *Parkia javanica* (Lam.) Merr., *Adenanthera intermedia* Merr., and *Calliandra inaequilatera* Rusby had no nodules, but the rest showed varying percentages of nodulation. The *Mimosa* species were 100 per cent nodulated. The nodules were heavily scattered throughout the entire root system. They varied in shape; many were elongated and the others were round and branched. They were pinkish and soft. The lowest percentage of nodulation occurred in *Samanea saman* (Jacq.) Merr., only 12 out of 20 plants being nodulated.

Fifty-one species were observed of the subfamily Papilionatae. The species of *Centrosema, Clitoria, Calopogonium, Dolichos, Pueraria, Psophocarpus,* and *Vigna* were 100 per cent nodulated. Numerous large, white, and rough-surfaced nodules were found on their root systems. Among the herbaceous plants, the *Crotalaria* species had 100 per cent nodulation. Large and small nodules were found on the root systems of the plants. The nodules were pinkish, soft, and branched.

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[5] F. Nobbe, E. Schmid, L. Hiltner, and E. Hotter, *Landw. Vers. Sta.,* **39**, 327 (1891). Cited in *Soil Sci.,* **42**, 87 (1936).

[6] W. B. McDougal, *Amer. Jour. Bot.,* 8, 171 (1921). Cited in *Soil Sci.,* **42**, 87 (1936).

[7] N. V. Joshi, *India Dept. Agric. Mem. Bact. Ser.,* 1, 247 (1920). Cited in *Soil Sci.,* **42**, 87 (1936).

Erythrina variegata var. *orientalis* (L.) Merr., *Sesbania grandiflora* (L.) Pers., and *Pterocarpus indicus* Willd. were the most heavily nodulated among the trees. All six of the *Erythrina variegata* var. *orientalis* (L.) Merr. trees bore large, light-brown, and smooth-surfaced nodules. The nodules were mostly found on the upper part of the root system. Nodules on *Sesbania grandiflora* (L.) Pers. were mostly on the lateral roots. Five out of six trees that were examined had nodules. The nodules were large and smooth-surfaced. Ten out of 15 *Pterocarpus indicus* Willd. plants were nodulated. They had round, light-brown, and rough-surfaced nodules mostly on the lateral roots. *Gliricidia sepium* (Jacq.) Steud. showed the least percentage of nodulation among the trees of the Papilionatae subfamily (table 1).

All the stained smears prepared from nodulated species showed presence of bacteria only.

TABLE 1

Leguminous plants surveyed in the Central Experiment Station, Los Baños, Laguna, and in Calamba, Laguna

SCIENTIFIC NAME	NO. OF PLANTS EXAMINED	NODULES			
		Present	Percentage	Absent	Percentage
CAESALPINIOIDEAE					
Bauhinia acuminata L.	8	0	0	8	100
Bauhinia cumingiana (Bent.) F.-Vill.	4	0	0	4	100
Bauhinia malabarica Roxb.	1	0	0	1	100
Bauhinia monandra Rurz	4	0	0	4	100
Bauhinia purpurea Vid.	8	0	0	8	100
Bauhinia tomentosa L.	2	0	0	2	100
Brownea grandiceps Jacq.	1	0	0	1	100
Caesalpinia coriaria (Jacq.) Willd.	2	0	0	2	100
Caesalpinia pulcherrima (L.) Sw.	14	0	0	14	100
Cassia alata L.	10	0	0	10	100
Cassia bacillaris L. F.	2	0	0	2	100
Cassia fistula L.	1	0	0	1	100
Cassia hirsuta L.	2	0	0	2	100
Cassia javanica L.	3	0	0	3	100
Cassia mimosoides L.	10	10	100	0	0
Cassia occidentalis L.	20	1	5	19	95
Cassia siamea Lam.	10	0	0	10	100
Cassia tora L.	20	0	0	20	100
Delonix regia (Boj.) Rei.	20	0	0	20	100
Haematoxylon campechianum L.	4	0	0	4	100
Hymenaea courbaril L.	15	10	66.7	5	33.3
Mezoneurum cucullatum (Roxb.) W & A	10	0	0	10	100
Pahudia rhomboidae (Blanco) Prain	6	0	0	6	100
Peltophorum pterocarpum Backer	1	0	0	1	100
Saraca declinata Miq.	1	0	0	1	100
Schizolobium excelsum Vogel	10	0	0	10	100
Sindora supa (Blanco) Merr.	5	0	0	5	100
Tamarindus indica L.	20	0	0	20	100
MIMOSOIDEAE					
Acacia confusa Merr.	3	3	100	0	0
Acacia farnesiana (L.) Willd.	10	8	80	2	20
Adenanthera intermedia Merr.	4	0	0	4	100
Albizzia lebbeck (L.) Benth.	3	3	100	0	0
Calliandra inaequilatera Rusby	4	0	0	4	100
Entada phaseoloides (L.) Merr.	1	1	100	0	0
Leucaena glauca (L.) Benth.	20	14	70	6	30
Mimosa invisa Hart.	20	20	100	0	0
Mimosa pudica L.	20	20	100	0	0
Parkia javanica (Lam.) Merr.	6	0	0	6	100
Pitheocolobium dulce (Roxb.) Benth.	20	16	80	4	20
Samanea saman (Jacq.) Merr.	20	12	60	8	40
PAPILIONATAE					
Abrus precatorius L.	20	20	100	0	0
Aeschynomene indica L.	20	20	100	0	0
Alysicarpus nummularifolius (L.) DC.	20	20	100	0	0

TABLE 1 (continued)

SCIENTIFIC NAME	NO. OF PLANTS EXAMINED	NODULES			
		Present	Percentage	Absent	Percentage
Alysicarpus vaginalis (L.) DC.	20	20	100	0	0
Arachis hypogea L.	20	20	100	0	0
Cajanus cajan (L.) Merr.	20	20	100	0	0
Calopogonium mucunoides Desv.	20	20	100	0	0
Canavalia ensiformis (L.) DC.	5	5	100	0	0
Centrosema plumieri (Turp.) Benth.	20	20	100	0	0
Centrosema pubescens Benth.	20	20	100	0	0
Clitoria ternatea L.	20	20	100	0	0
Crotalaria anagyroides HBK.	20	20	100	0	0
Crotalaria bracteata Roxb.	20	20	100	0	0
Crotalaria incana L.	20	20	100	0	0
Crotalaria juncea L. Sunn Hemp.	20	20	100	0	0
Crotalaria mucronata Desv.	20	20	100	0	0
Crotalaria quinquefolia L.	20	20	100	0	0
Dalbergia ferruginea Roxb.	6	4	66.7	2	33.3
Derris elliptica (*Roxb.*) Benth.	1	1	100	0	0
Derris philippinensis Merr.	1	1	100	0	0
Desmodium capitatum (Burm. F.) DC.	20	20	100	0	0
Desmodium gangeticum (L.) DC.	20	18	90	2	10
Desmodium heterophyllum (Willd.) DC.	20	20	100	0	0
Desmodium laxiflorum DC.	10	8	80	2	20
Desmodium procumbens (Mill.) A. S. Hitchc	20	20	100	0	0
Desmodium pulchellum (L.) Benth.	20	14	70	6	30
Desmodium scorpiurus (Sw.) Desv.	20	20	100	0	0
Desmodium triflorum (L.) DC.	20	20	100	0	0
Desmodium virgatum Zoll.	8	6	75	2	25
Dolichos lablab L.	8	8	100	0	0
Erythrina variegata var. *orientalis* (L.) Merr.	6	6	100	0	0
Flemingia strobilifera (L.) R. Br.	20	17	85	3	15
Gliricidia sepium (Jacq.) Steud.	20	5	25	15	75
Glycine max (L.) Merr.	20	20	100	0	0
Indigofera hirsuta L.	20	18	90	2	10
Indigofera suffruticosa Mill.	9	9	100	0	0
Lourea vespertillones (L.) Desv.	4	4	100	0	0
Pachyrrhizus erosus (L.) Urb.	20	20	100	0	0
Phaseolus lunatus L.	10	10	100	0	0
Phaesolus radiatus L.	20	20	100	0	0
Psophocarpus tetragonolobus (L.) DC.	8	8	100	0	0
Pterocarpus indicus Willd.	15	10	66.7	5	33.3
Pueraria javanica Benth.	20	20	100	0	0
Sesbania grandiflora (L.) Pers.	6	5	83.3	1	16.7
Strongylodon macrobotrys A. Grav.	1	1	100	0	0
Tephrosia candida (Roxb.) DC.	1	1	100	0	0
Tephrosia dichotoma Desv.	10	10	100	0	0
Tephrosia purpurea (L.) Pers.	5	4	80	1	20
Uraria lagopodioides (L.) Don	20	18	90	2	10
Vigna sesquipedalis Fruw.	20	20	100	0	0
Vigna sinensis (L.) Savi	20	20	100	0	0

FARMING METHODS AND RETURNS ON 126 RICE FARMS IN ROXAS, ISABELA, IN 1952 [1]

C. A. Bratton and L. S. Robertson [2]

Eighty-four of the 126 farms were owner-operated, 38 were tenant-operated, and 4 were partly owned and partly tenanted. The owner-operated farms averaged 7.3 hectares and the tenant farms, 2.4 hectares. In each of the 3 tenure groups, rice occupied an average of 94 to 97 per cent of the land. Carabaos were the only source of animal power. Few productive livestock were kept. Owner operators averaged ₱4374 capital and tenants, ₱685. Land constituted 75 per cent of the owner operator's capital and nearly 40 per cent of the tenant's capital.

Owner operators averaged 40 years of age and tenants, 36. Owner operators had completed an average of 1.3 school grades and tenants, 1.6. Seventy-five per cent of the owner operators and 63 per cent of the tenants had had no schooling. Families averaged 5 persons. Operators furnished about one-half of the family labor supply. The average farm provided the operator with 4.2 months of work.

Wagwag and Los Baños varieties were the usual varieties of rice planted, and the *palusal* method of seed preparation was generally used. Owner operators plowed and harrowed more than the tenants. Palay merchants were the most common buyers of palay. Rice took up an average of 60 days of labor per hectare on the owner-operated farms and 67 days on the tenant farms. All but 3 of the owner operators and all but 1 of the tenants received loans during the year.

The gross farm receipts were ₱1238 for owner operators and ₱307 for tenants. Farm expenses averaged ₱561 for owner operators and ₱275 for tenants. This left a net farm income of ₱677 for owner operators and ₱34 for tenants. The value of privileges furnished by the farms averaged ₱129 on owner-operated farms and ₱66 on tenant farms. The labor incomes of the two groups averaged ₱414 and ₱7, respectively, and the labor earnings, ₱543 and ₱59. Operators and their families supplemented farm returns by working off the farm for an average of ₱180 for owner operators and ₱124 for tenants. The total net amount available to families for living expenses, education, investment, and other uses averaged ₱1138 on the owner-operated farms and ₱322 on the tenant farms. Incomes varied widely among farms, partly as a result of factors within the control of farm operators.

What incomes are made by farm families in Northern Luzon? What capital and labor do they provide to earn these incomes? How do methods of farming affect the incomes?

The answers to questions such as these were sought in a study of rice farms in barrio San Antonio No. 2, Roxas, Isabela, by the Department of Agricultural Economics in the summer of 1953. The study revealed information that should be helpful to farmers operating under similar conditions and to officials planning and carrying out public agricultural programs.

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[1] Central Experiment Station Contribution No. 1751. Prepared in the Department of Agricultural Economics, based on a survey conducted by Mr. Isabelo A. Amurao.

[2] Visiting professors of agricultural economics.

The study involved 126 farms chosen to be representative of all farms similarly operated. The operator of each of these 126 farms furnished, in an interview, a detailed "survey" record of his farm setup, practices, receipts, expenses, and other items for 1952.

The area surveyed is located in the center of the Mallig region, the rice granary of the province of Isabela. It lies between the Magat and Sibul rivers and is almost at the foot of a mountain. Rice is the principal crop; only one crop a year is planted because of lack of irrigation facilities. Corn and a few vegetables are also grown, but to a limited extent. Transportation facilities are very poor, and the roads are rugged, dusty during the dry season, and muddy in the rainy season. Houses are far apart; only a few farmers have their dwellings near their farms.

ORGANIZATION AND PRACTICES ON THE 126 FARMS

Tenure of farm

Eighty four of the 126 farmers owned all the land they operated, 38 were tenants, and 4 partly owned and partly tenanted their land. The percentage of full owners was slightly larger, and that of part owners smaller, than those reported by the 1948 census for the entire province of Isabela, as shown below:

	126 FARMS STUDIED	ISABELA (1948 CENSUS)
Owners	67	58
Part owners	3	11
Tenants	30	31

Size of farm and use of land

The 84 owner-operated farms ranged in size from 1 to 33 hectares and averaged 7.3 hectares. The 38 tenant-operated farms ranged only from 1 to 6 hectares, averaging 2.4 hectares. Each of the 4 part owners owned 1 to 2 hectares and tenanted another 1½ or 2 hectares.[3]

The average size of the owner-operated farms in the sample of 126 was slightly larger than the average of the province of Isabela as reported by the 1948 census, but the tenant-operated farms averaged the same size, as shown below:

	126 FARMS STUDIED	ISABELA (1948 CENSUS)
	hectares	*hectares*
Owners	7.3	5.3
Part owners	3.5	3.9
Tenants	2.4	2.4

In each of the three tenure groups an average of 94 to 97 per cent of the total farm area was used for rice production.

[3] Because of the small number of partly owned farms, they are omitted in most of this report.

Livestock

Carabaos were the only work animals used. Owner operators having larger farms than tenants owned an average of more than twice as many carabaos as the tenants. The average number of productive livestock (other than work animals) was small, particularly on the tenant-operated farms:

	OWNERS	TENANTS
Carabaos	1.8	.8
Boars	.1	.1
Sows	.5	.2
Pigs	1.9	1.0
Hens	2.4	2.6
Pullets	1.8	.7
Roosters	.6	.5
Chickens	8.3	8.6
Ducks	1.4	.7

Farm capital

Land constituted 75 per cent of the ₱4374 average capital of the owner operators, and work animals constituted 15 per cent. Most tenants owned their own farmstead area, and the value of this land made up nearly 40 per cent of the ₱685 average farm capital of a tenant. Tenants had much less of their own money invested in various capital items than owner operators, as shown below:

Land	₱3,269	₱270
Dwelling	227	77
Other buildings	74	9
Work animals	461	177
Other livestock	123	39
Tools and equipment	168	93
Supplies	52	20
Total	₱4,374	₱683

Characteristics of the farm operators

Age. Owner operators averaged 40 years of age and tenants, 36 years. Approximately one-half (40) of the owner operators were from 33 to 44 years old. More than one-half (20) of the tenants were from 27 to 38 years old, and 2 were more than 50 years old.

Education. Owner operators had completed an average of 1.3 grades of school. Tenants, having started schooling at a slightly later period, had completed an average of 1.6 grades. Seventy-five per cent of the owner operators and 63 per cent of the tenants had not completed any grade.

Farming experience. Owner operators had farmed an average of 19 years and tenants, an average of 15. The owners had been on the same farm for an average of 7 years and tenants, an average of less than 3 years.

Size of family. The families of owner operators and tenants averaged about five persons. The typical farm couple had 1 or 2

sons, 1 or 2 daughters, and an occasional other relative living with them.

	OWNERS	TENANTS
Operator	1.0	1.0
Wife	1.0	.8
Sons	1.6	1.9
Daughters	1.2	1.3
Others	.1	Less than 0.05
	4.9	5.0

Family labor. Operators furnished about one-half of the family labor supply. The farm provided the operator with work for only about one-third of the year. The breakdown in months of the family labor was as follows:

	OWNERS	TENANTS
Operator	4.2	4.2
Wife	1.9	2.1
Sons	2.3	.8
Daughters	.3	.4
	8.7	7.5

Farming practices

Rice production. All but 1 of the 126 rice growers planted either Wagwag or Los Baños varieties of rice, and most of them planted both. Only 4 planted some other variety on part of their rice land.

None of the rice fields was irrigated.

The average rate of seeding of rice by both owner operators and tenants was 3.2 cavans per hectare. The *palusal* method of seed preparation was used on all farms except on 3 tenant farms. Eleven owner operators and 1 tenant also used the *bakal* system on part of their land.

Owner operators tended to prepare their land better than tenants. Seven owners plowed 3 times, 7 plowed 4 times, and 4 plowed 5 times, whereas only 1 tenant plowed more than once. Owner operators harrowed an average of 3 times as compared to twice by tenants. The average interval between plowings was 1.2 weeks; that between harrowings was 2.4 weeks on the owner-operated farms and 1 week on the tenant farms.

Palay merchants were the most common buyers of palay. Buyers came in from Tarlac, Nueva Ecija, Bulacan, Pampanga, and Manila.

Labor on palay. About one-half of the family labor for the farm was used on palay, an average of 134 days on owner-operated farms and 159 days on tenant farms. Owner operators hired nearly twice as much palay labor (254 days) as that furnished by the family, and tenants nearly one-half as much (65 days). This did not include threshers who worked for a share of the crop.

The total palay man labor requirement per hectare (not including harvesting on shares) was about sixty days on the owner-operated farms and sixty-seven days on the tenant farms. Plowing and harrowing used up more than one-half of the labor on tenant farms where there were fewer plowings and harrowings. The breakdown of the labor requirement in days per hectare of rice was as follows:

	OWNERS	TENANTS
Repairing dikes	4.4	7.2
Preparing seedbed	1.3	1.6
Plowing	16.7	10.1
Harrowing	15.4	8.0
Planting	8.8	17.7
Harvesting	9.7	16.8
Hauling	1.5	2.5
Piling and stacking	1.6	2.5
Hauling palay	.2	.4
Total	59.6	66.8

The operators put most of their own labor in plowing and harrowing. On owner-operated farms, however, more labor was hired. Nonoperator family labor did most of the repairing of dikes, preparing of seedbeds, and hauling and stacking. The percentage of rice work done by various kinds of labor is shown below:

	OWNERS			TENANTS		
	Op.	Fam.	Hired	Op.	Fam.	Hired
Repairing dikes	1	98	1	—	100	—
Preparing seedbed	—	100	—	—	100	+
Plowing	72	3	25	2	9	89
Harrowing	77	3	20	1	7	92
Planting	90	1	9	94	3	3
Harvesting	72	18	10	53	21	26
Hauling	—	100	—	—	100	—
Piling and stacking	—	100	+	—	100	—
Hauling palay	73	27	—	89	11	+
Total	66	19	15	39	29	32

Miscellaneous practices. Only 1 of the owner operators and none of the tenants kept farm records. One owner operator and none of the tenants stated that he was trying to follow a definite plan of farming. Only 1 owner and 2 tenants read any farm papers. Thirty seven per cent of the owner operators and 26 per cent of the tenants were members of some farm organization.

Credit. All but 3 of the owner operators and all but 1 of the tenants borrowed money or commodities one or more times during the year. Landlords were the lenders in one-third of the loans to tenants. Owner operators tended to borrow more from relatives and from miscellaneous sources such as individuals and palay merchants. The sources of credit were as follows:

	OWNERS *per cent*	TENANTS *per cent*
Store	6	9
Landlord	—	35
Relatives	28	15
Banks	15	6
Others	51	35
Total	100	100

FINANCIAL RETURNS

Farm receipts

The gross farm receipts of owner operators averaged ₱1268. After giving the harvesters their share of crops worth ₱56, the owner operators had enough of the crops for sale to bring in an average of ₱1117. Of this amount, ₱459 went directly to creditors in discharge of debts. Practically all of the crop receipts came from palay.

Livestock and livestock product sales accounted for 5 per cent of the owner operator's gross receipts; increase in inventory accounted for an even smaller amount.

After turning over to the landlord and harvesters their share of crops worth an average of ₱291 and ₱26, respectively, the tenants averaged gross receipts of only ₱307. Nearly all of this was from the sale of palay. An average of ₱196 went directly to creditors in payment of debts.

	OWNERS	TENANTS
Crops sold	₱ 658	₱100
Crops turned over to creditors	459	196
Livestock and livestock products sold	52	11
Increase in inventory	68	—
Miscellaneous	1	—
	₱1,238	₱307

Farm expenses

Farm operating expenses averaged ₱409 on the owner-operated farms and ₱176 on the tenant-operated farms. These expenses did not include the landlord's and harvesters' shares of crops which were not credited as receipts. In addition, the family members other than the operator contributed farm labor worth an average of ₱152 on the owner-operated farms and ₱99 on the tenant farms, which may be considered an additional expense.

	OWNERS	TENANTS
Livestock bought	₱ 71	₱ 21
Hired labor	128	51
Tools bought	6	2
Miscellaneous cash expense	204	93
Value of family labor	152	99
Decrease in inventory	—	9
	₱561	₱275

Net farm income

The farm income, or margin between gross receipts and operating expenses, was ₱677 for the owner operators and only ₱34 for the tenants. This did not include the value of the operator's own labor or capital and the value of privileges, or products furnished by the farm for family living.

Farm privileges

The owner-operated farms furnished an average of ₱129 worth of products for family living and the tenant farms, an average of ₱66. This included the use of the dwelling. Crops constituted by far the largest part of these privileges, the palay consumption alone amounting to 10.7 cavans on the owner-operated farms and to 5.2 cavans on the tenant farms.

	OWNERS	TENANTS
Use of dwelling	₱ 26	₱13
Hogs	11	1
Poultry	5	2
Eggs	1	1
Palay	75	39
Other crops	11	10
	₱129	₱66

Labor returns

The average net farm income of ₱676 on owner-operated farms can be considered the reward the operator got for his own labor and for the use of his capital. When 6 per cent interest on his farm capital was subtracted from his farm income, the operator's labor income was ₱414. Figured in the same way, the average labor income of the tenants was minus ₱7; the tenants lacked an average of ₱7 of making 6 per cent interest, or got nothing for their own labor.

If the value of the privileges is added to the labor income, the owner operators made average labor earnings of ₱543 and the tenants, of ₱59. The labor earnings are the best measure of returns of various farms when privileges are large in proportion to cash receipts.

	OWNERS	TENANTS
Net farm income	₱677	₱33
6% interest on farm capital	262	40
Operator's farm labor income	414	−7
Value of farm privileges	129	66
Operator's farm labor earnings	543	59

Off-farm work

With the farms furnishing the operators with an average of only one-third of a year's employment, 20 per cent of the owner operators and 16 per cent of the tenants found some work off the farm. Many other members of the family also did off-farm work to supplement the farm returns.

	OWNERS	TENANTS
Operator's labor	₱91	₱82
Labor of other family members	89	42

Total family returns

The average net amount available to the farm family for cash living expenses, education, investment, or other purposes was the sum of the operator's farm labor earnings and off-farm earnings, plus the charge made for interest on capital and for the farm labor of members of the family, neither of which was actually paid in cash. This average amount available was ₱1138 on the owner-operated farms and ₱322 on the tenant farms.

Variation in income among farms

Farms, particularly those operated by their owners, varied widely in returns. Sixteen of the owner operators had minus labor incomes, or failed to make 6 per cent interest on the capital without figuring any charge for their own labor. Twenty-four others each made a labor income of less than ₱275; 36 others made between ₱275 and ₱1046; and 8 made more than ₱1046.

Ten of the tenants had minus labor incomes; 20 made from ₱15 to ₱186; and 8 made more than ₱186.

Causes of variation in incomes

Some of the reasons for variation in returns from farm to farm are largely outside the control of the farm operator. Many others are within his control. His income is affected greatly by the decisions he makes in connection with his farm operations. The varieties of crops he grows, the kind and amount of fertilizer he applies, the means he uses to control insects or diseases or weeds, the kind of preparation he gives his land, the timing of his various field operations, the efficiency with which he uses his labor, the completeness with which he recovers his palay in threshing, the prices he pays for farm supplies and equipment, and the way he sells his farm products—these and many other farm practices on which he has to make decisions have an important bearing on his returns.

The influence of many of these factors can not be measured separately in a study of this kind. Each one, however important, may lose its effect in combination with other factors. The influence of a few factors, to the extent that it could be measured, is reported below.

Size of farm. The number of hectares an owner operator farmed had a marked influence on the returns he made. The labor income and labor earnings were larger on the larger farms. Both of these measures showed returns above the extra cost of interest for the larger capital invested.

HECTARES TO AN OWNER-OPERATOR		NUMBER	LABOR	LABOR
Range	Average	OF FARMS	INCOME	EARNINGS
1–2	2	20	₱108	₱205
3–5	3.9	36	394	487
6–33	12.8	28	658	857

Crop yield. The average yield of palay was 35 cavans per hectare on the owner-operated farms and 46 cavans on the tenant farms. Yields ranged from 9 to 77 cavans for owner operators and 11 to 63 cavans for tenants. Yields were affected by many practices under the control of the operators. Higher yields naturally were associated with higher costs, but the higher costs apparently were justified, as the labor incomes tended to be definitely related to the palay yields obtained. The 29 owner-operated farms with yields from 9 to 26 cavans had an average labor income of ₱232, as compared to ₱150 for the 55 owner operators with yields of over 26 cavans. The tenants with yields of 50 cavans or more were the only tenants who averaged at least an interest on their capital, as shown below:

CAVANS PALAY PER HECTARE		NUMBER OF	AVERAGE LABOR
Range	Average	TENANT FARMS	INCOME
11–37	26	12	₱−38
39–49	42	13	−21
50–63	54	13	111

The relationship between most of the factors affecting labor income and the returns is not a "straight line" relationship. It can not be assumed, for example, that increasing yields will indefinitely always result in higher returns. The point of diminishing returns, however, is well above the yields obtained on most of the farms.

Education of operator. Among owner operators no relationship between education and returns was apparent. The difference in education was so small that any influence it may have had was obscured by other factors. Among tenants there was a consistent relationship between amount of education and size of labor income although the relationship was of questionable statistical significance. Tenants with no education lacked an average of ₱25 of making any labor income; those who had completed 2 to 4 grades made average labor incomes of ₱55; and those who had completed 5 grades or more made average labor incomes of ₱123.

GERMINATION OF VANILLA SEEDS[1]

NICASIO T. DOMINGO, JR.

WITH THREE TEXT FIGURES

Vanilla seeds planted under diffuse light and at room temperature germinated in about three month. Bouriquet's vanilla decoction agar appeared to be more efficient as a germinating medium for vanilla seeds than either coconut water agar or tomato juice agar. The growth of the seedlings in the coconut water agar was not very satisfactory, but this disadvantage was made up for by the availability, economy, and ease of preparation of the medium. No germination took place in the tomato juice medium.

Vanilla planifolia Andr. (*V. fragrans* Ames.) is a tropical plant belonging to the orchid family. A native of Mexico, this species is considered the best one for commerce.

The vanilla plant is commonly propagated by cuttings, but in some cases, it has been raised from seeds. Though it is probable that growing vanilla from seeds is too slow a process for the practical farmer, there is a good deal to be said for its being occasionally done, especially in connection with hybridization programs through which new and desirable strains may be developed. It is therefore important to find a suitable and economical medium for germinating vanilla seeds.

According to Vacin and Went (1949), Knudson stated in 1946 that it was generally recognized that the critical pH range of the solution for satisfactory germination of orchid seeds was between pH 4.5 and 5.5. In a later experiment, Knudson (1951) noted that for best growth the pH value of the culture medium should be about pH 5.0.

Cultures of vanilla seeds maintained under conditions of darkness at 32°C., according to Knudson (1950), germinated earlier than those incubated at 28°C. and at 25°C. He also reported that Bouriquet (1937) observed that on a decoction of vanilla plant parts and soil, vanilla seeds germinated in about seven months when the cultures were kept in darkness and incubated at 27°C. When the cultures were exposed to diffuse light at 27°C., the seeds germinated in approximately three months.

To study three methods of germinating vanilla seeds and to determine the length of time required for germination, the present work was conducted from April, 1952, to January, 1953, in the lab-

[1] Central Experiment Station Contribution No. 1752. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agronomy under the direction of Dr. Pedro A. David.

oratories of the Departments of Agronomy and Plant Pathology, College of Agriculture and Central Experiment Station, Los Baños, Laguna.

MATERIALS AND METHODS

Medium I. Coconut water agar was prepared by taking fresh coconut water and shreds of agar and carefully measuring them into one set of 10 bottles. The bottles were plugged with cotton and autoclaved for 15 minutes at 15 pounds pressure. Then the agar solution was allowed to cool and harden so that a sloped surface was provided.

Medium II. Except for the kind and the increased amount of agar used in the present experiment, the formula and the method which had been worked out by Bouriquet (1937) were followed in preparing vanilla decoction agar.

Medium III. The tomato juice agar used by Meyer (1945), with some modifications, was prepared as the third medium. Sucrose was added to the filtered juice of tomato to assure a sufficient supply of sugar (Vacin and Went, 1949) and to achieve a consistent germination (Knudson, 1922). The solution was measured into a third set of 10 bottles and then autoclaved. Another set of bottles containing distilled water and agar was also sterilized in the autoclave. After the autoclaving, the tomato juice and the agar solution were mixed aseptically. The initial pH readings of the three culture media were taken, but not adjusted, after the autoclaving.

Sowing of the seeds. Seeds were scraped off from mature vanilla pods by means of a scalpel and were treated with 70 per cent calcium hypochlorite solution for 15 minutes to kill any microorganisms which might have adhered to them. The hypochlorite solution was afterwards washed away with sterile distilled water.

With a sterilized wire loop, vanilla seeds were introduced into each culture bottle and spread carefully on the surface of the agar medium. Seed transfer was done inside the transfer chamber to minimize contamination. The culture bottles were then placed under diffuse light and at room temperature. Actually, however, the room temperature[2] varied considerably: from 21.9° to 35.1°C. in April, from 22.7° to 35.0°C. in May, and from 20.4° to 34.8°C. in June.

Observations. Germination and other observations were noted and recorded during the experiment.

In photographing the seedlings, they were mounted on the stage of a microscope which had been so adjusted as to enable the taking of pictures from the same observational point that one looked into the apparatus. Magnifications of the photographed seedlings were taken by dividing the measurement of the seedlings in millimeters by the ocular measurement, also in millimeters, and then multiplying the product by 0.015.

[2] Data supplied by the Department of Engineering.

DISCUSSION OF RESULTS

During the first four days, contamination was low (5.9 per cent) in all the culture media. The heaviest contamination occurred three weeks after planting. In medium I the percentage of contamination was 8.3; in medium II, 7.1; and in medium III, 75.0.

Out of the 1093 seeds planted, 158 germinated: 106 in medium II, the vanilla decoction agar, and only 52 in medium I, the coconut water agar (table 1). The seeds did not germinate at the same time. Knudson (1950) attributed this fact to the inadequacy of the method employed to bring the vanilla seeds out of the dormant stage.

It took 88 to 102 days for the seeds to germinate in medium I and from 74 to 105 days in medium II. The reason for the failure of the seeds to germinate in medium III under the same conditions which proved favorable to the germination and growth of the seeds in media I and II is not known. Knudson (1950) stated that the germination of vanilla seeds has been a perplexing problem because the methods used in germinating various orchid seeds have been ineffective with vanilla.

Although the temperatures under which the experiment was conducted differed greatly from those Bouriquet (27.0°C.) in 1937 and Knudson (32.0°C.) in 1950 found to be favorable for germination, germination was noted in about three months in culture media I and II.

The first sign of germination (fig. 1, left) is the rupture of the seed coat and the subsequent emergence of the embryo. A more

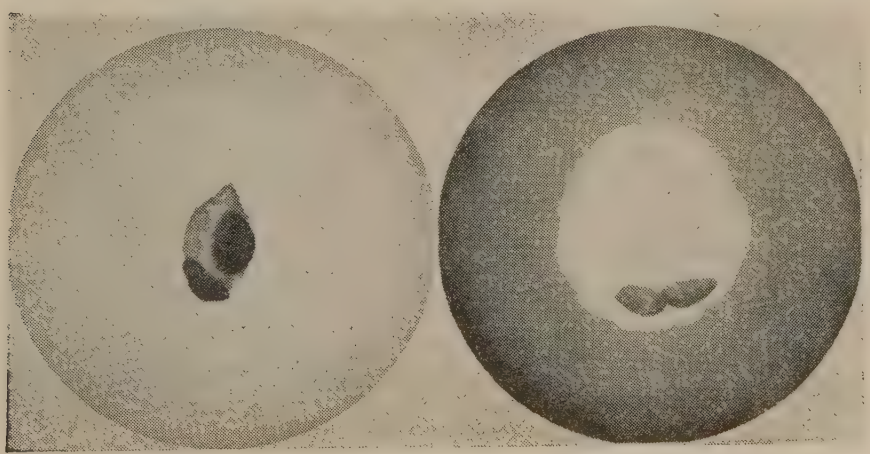

Fig. 1.—Left, the embryo after rupture of seed coat; age about three weeks. 35×. Right, enlarged embryo two months after germination. 35×. (*Photographed by Dr. J. Banzon, Photographic Division.*)

rapid growth follows (fig. 1, right), as manifested by the enlarged embryo and the further increase in size of the seedling, until the

first leaf primordium (fig. 2, left) is formed. The seed coat, which has been broken into halves as a result of the embryonic development, still adheres to the embryo. At about four months of age (fig. 2, right), a top-shaped protocorm is formed, and the two leaf

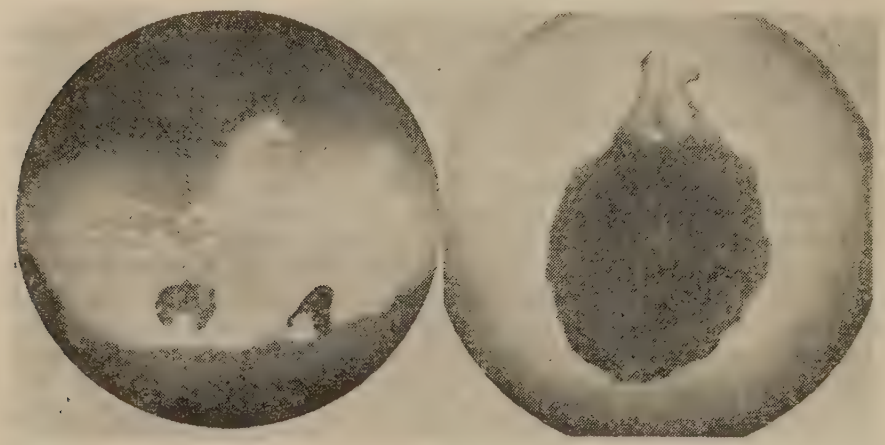

Fig. 2.—Left, appearance of the first leaf primordium three months after germination. 35×. Right, a four-month-old seedling, showing two leaf primordia. 35×. (*Photographed by Dr. J. Banzon, Photographic Division.*)

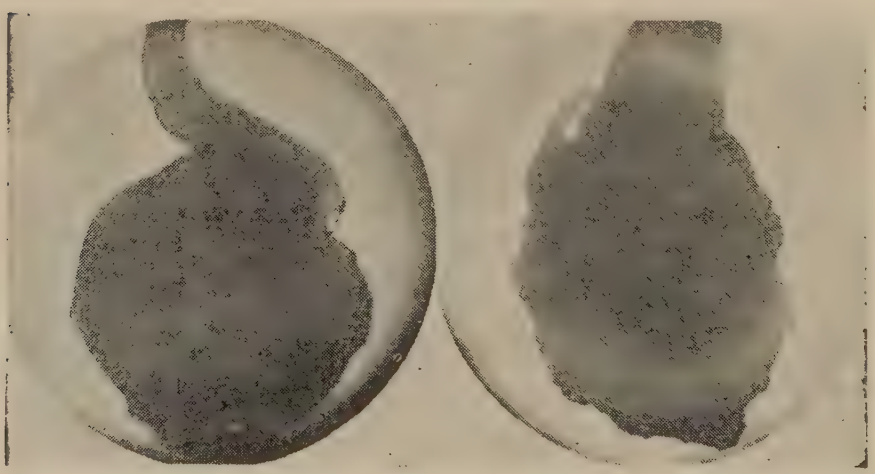

Fig. 3.—Left, a five-month-old seedling. The presence of chlorophyll was noted at this stage. 35×. Right, a six-month-old seedling, showing early stage of rhizoid formation. 35×. (*Photographed by Dr. J. Banzon, Photographic Division.*)

primordia become more established and prominent. Although the protocorm is well developed, it lacks chlorophyll and is white in color. The growth gradually becomes more rapid (fig. 3, left) until the al-

ready enlarged leaf primordium acquires a distinct green tinge at the tip. In the more advanced form of the seedling (fig. 3, right), although no distinct rhizoid is formed, small protruding structures appear, denoting the early stage of rhizoid formation.

Differences among the seedlings in media I and II were observed about two and a half months after germination. The plants in medium I generally had well-expanded protocorms and well-defined leaf primordia, but only a few seedlings had chlorophyll. This lack of chlorophyll continued even after six months of growth. The seedlings grown on medium II were markedly bigger and sturdier than those on medium I. About thirty per cent of the seedlings in medium II had chlorophyll.

After three months the seedlings grown on medium II showed a green tinge, whereas those on medium I did not. At six months, two-thirds of the seedlings in medium II had chlorophyll. Medium I, on the other hand, had only four distinctly green-colored seedlings. The weight of the seedlings grown on medium II was more than twice as great as that of the seedlings grown on medium I (table 2).

Since the seedlings were entirely dependent upon the stratum on which they were developing, the deficiency exhibited by the seedlings grown on medium I may have been due to the less acidic nature of that medium (pH 5.5) as compared with medium II (pH 4.9). Laurie and Ries (1950) stated that "the pH range of the solution should be between 4.5 and 5.2; otherwise, the growth of orchid seeds would be poor."

The initial pH values of the two culture solutions were not maintained during the experiment; there was a change in the reading after 283 days (table 2). A change in the pH was also noted by Vacin and Went (1949) when they planted seeds of *Epidendrum o'brienianum* in Knudson's solution C. Knudson (1951), who used his solution C and Vacin and Went's solution 5 as germinating media for Cattleya seeds, also made the same observation.

From the results obtained, medium II seems to be more adequate than medium I for the germination and growth of the vanilla seedlings. However, although the growth of vanilla seedlings in the coconut-water-agar medium was not very satisfactory, the disadvantage was compensated for by the availability, economy, and ease of preparation of the medium.

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TABLE 1

Percentage of germination and number of days at germination of the vanilla seeds in two culture media

CULTURE BOTTLE NO.	CULTURE MEDIA			
	Coconut water agar		Vanilla decoction agar	
	No. of seeds planted	No. of seeds germinated	No. of seeds planted	No. of seeds germinated
1	44	6	60	8
2	33	0	59	7
3	24	5	57	6
4	53	9	31	7
5	37	4	38	7
6	34	5	48	7
7	42	5	44	7
8	34	5	32	6
9	35	4	97	21
10	37	2	56	10
11	28	2	60	7
12	30	5	46	10
13	—	—	34	3
Total	431	52	662	106
Percentage of germination	12.06		16.01	
Mean number of days at germination	95.0		89.5	

TABLE 2

Weight of vanilla seedlings after 283 days and change in pH value of two culture media

CULTURE MEDIUM	INITIAL pH	FINAL pH	FRESH WEIGHT OF 20 SEEDLINGS
			mg.
Coconut water agar	5.5	4.3	640.0
Bouriquet's vanilla decoction agar ...	4.9	3.7	1,826.0
Tomato juice agar	5.5	—	—

NOTES ON COFFEE RUST AND ABACÁ MOSAIC INCIDENCE IN GUINOBATAN, ALBAY [1]

G. O. Ocfemia

WITH ONE TEXT FIGURE

Remnants of *Coffea arabica* Linn. may still be found in Guinobatan, Albay, and its vicinity, but they are all heavily infected with the rust fungus, *Hemileia vastatrix* B. and Br.

Although mixed infection of bunchy-top and mosaic occurs in the variety collections of the Abacá Experiment Station in Banao, the mosaic disease appears to be absent from plants in private abacá fields.

On the trip to Guinobatan, Albay, made from November 28, 1953, to December 5, 1953, inclusive, to evaluate the work of the Bureau of Plant Industry on the cadang-cadang disease of coconut in the Guinobatan Abacá Experiment Station in Banao, the writer also went out to see whether or not *Coffea arabica* Linn. and its associated *Hemileia vastatrix* B. and Br. can still be found in Guinobatan, Albay. In addition, the writer made short side trips to determine whether or not the mosaic disease occurs in private abacá fields.

COFFEA ARABICA

Coffea arabica Linn., known in Guinobatan and its vicinity as "natural" or "antigo" and considered a much better coffee than any of the more recently introduced species, *C. robusta, C. excelsa, C. liberica,* etc., may still be found in isolated places. In these places the green leaves are used for preparing coffee tea when ground coffee is not available. Wherever *arabica* was found the rust fungus was associated with it.

On November 30, 1953, two bushes of *arabica* which had shed off most of their leaves were found in Barrio San Rafael, Guinobatan. Volunteer *arabica* seedlings were badly infected with the rust (fig. 1), like the seedlings received from Davao on September 12, 1953, through the courtesy of Mr. Prudencio Pacumbaba of the Abacá Mosaic Control Headquarters. A few berries were collected from the two bushes in San Rafael for planting in the College of Agriculture.

In the same morning a visit to Barrio Mauraro, Guinobatan, showed that all coffees in back yards and in abacá fields were the more recently introduced rust-resistant species.

In the afternoon a few group plantings of the more recently introduced coffees were noted on both sides of the road to Legaspi City. In Cabañgan, Camalig, near the Legaspi City boundary, between kilometers 540 and 541, were found *arabica* bushes said by the owner to be more than 20 years old. Both plants were seriously

[1] Central Experiment Station Contribution No. 1753.

Fig. 1.—A young *Coffea arabica* seedling with an abundance of sori of the rust fungus, *Hemileia vastatrix* B. and Br., on the nether surface of the leaves. Two of the leaves show large dead spots on the site of the original lesions. Nearly natural size. (*Photographed by the Photographic Laboratory, College of Agriculture.*)

infected with *Hemileia vastatrix*, but one of them had an abundance of berries. The owner did not believe that the yellow to orange spots of the rust fungus were the cause of the premature falling of the leaves. From the bush loaded with berries a few fruits were gathered and brought to the College for planting.

ABACA MOSAIC

Along with the search for *Coffea arabica* the writer examined abacá stools in private fields for the presence of mosaic disease. No cases of the disease, however, were noted.

On December 3, 1953, Mr. Domingo Baybay, in charge of the Guinobatan Abacá Experiment Station in Banao, showed the writer two long rows of plantings of Muray $\times$ Abuab F_1 in his abacá variety collection, 15 stools of which had a mixed infection of mosaic and bunchy-top. The writer suggested that all 15 hills be immediately removed and destroyed completely to prevent the two viruses from spreading in the field of the Station. Mr. Baybay promised to comply with the suggestion not later than December 5, 1953.

COLLEGE AND ALUMNI NOTES

In a special meeting held on January 8, 1954, the faculty approved a resolution expressing its feeling of deep loss at the death of Bienvenido M. Gonzalez, '13. It also approved a plan to establish an Alumni Center, which will be named after the late President. An organization committee, composed of Assistant Dean F. O. Santos (chairman), Dr. F. M. Fronda, and Dr. F. M. Sacay, was appointed to study ways and means of raising ₱50,000 for the construction of a building to house the Center. It is expected that the members of the faculty, employees, alumni, friends and admirers of the late President will heartily support the project.

Prof. A. H. Peterson, controller and director of finance at Cornell University, spent several weeks on the campus, conferring with College authorities and members of the Cornell group. He spoke at a seminar at the Department of Animal Husbandry on January 14, 1954.

The members of the Cornell group, led by Prof. Montgomery E. Robinson, were hosts to the members of the faculty and their better halves at a party at the Seniors' Social Garden on Friday afternoon, January 15, 1954.

Mr. Frank E. Moore, poultry consultant of the Foreign Operations Administration in Manila, and Dr. Amado E. Baladad, chief of the Poultry Division of the Bureau of Animal Industry, were recent campus visitors. They conferred with Drs. John K. Loosli and F. M. Fronda, of the Department of Animal Husbandry, regarding the chick feeding trials that are now being conducted in that department. The object of these feeding trials is to find out the possibility of utilizing copra meal in chick rations.

The College was selected as "the agricultural college of the year" for 1953 by the Business Writers' Association of the Philippines.

Advanced students in vegetable gardening made a trip to Baguio for the purpose of observing gardening practices in the Trinidad Valley. They were accompanied by Dr. L. G. Gonzalez, Dr. Paul Work, Dr. James Brewbaker, Mr. Teodoro Cadiz, Mr. Eusebio Inocencio, and Mr. Jose R. Deanon, Jr., of the Department of Agronomy, and Mr. Pelagio S. Fajardo of the UP Rural High School.

Members of the 1953 Agricultural Economics Club visited Baguio from December 27 to 29, 1953, for the purpose of observing vegetable growing and marketing. They were accompanied by Dr. L. S. Robertson, Prof. N. B. Tablante, and Mr. B. N. de los Reyes, of the Department of Agricultural Economics.

Dr. F. M. Sacay served as resource person in the commission on the improvement of rural livelihood at the annual national college

students' conference, which was held in Baguio from December 26 to 31, 1953, under the auspices of the YMCA and YWCA.

Major Virgilio T. Almeda, '37, is the present commandant of the Los Baños ROTC, succeeding Capt. Modesto V. Maligalig. Major Almeda is with the staff of the II MA, Camp Vicente Lim, at Canlubang, Laguna.

Mr. Sarot Montrakon (formerly Magdaleno Cero, '32) visited the College on January 15, 1954. Mr. Sarot was on his return trip to Bangkok, Thailand, from the United States, where he was sent by the FOA of Thailand to undergo observational training for five months. He was formerly assistant in soils in this College. He left for Bangkok some 18 years ago and this was his first visit since then. Until lately he was connected with the Department of Agriculture of Thailand as soil technologist; then he joined the Department of Rice Production, a newly created organization under the Ministry of Agriculture. Mr. Sarot was accompanied by Dr. Santiago A. Banilan, of the Irrigation Service Unit of the Department of Agriculture and Natural Resources.

The following alumni connected with the Bureau of Plant Industry left recently for the United States: Marcelino Constantino, '16, Juan O. Unite, '21, Eulalio P. Baltazar, '22, and Julian A. Agati, '23. As FOA-PHILCUSA trainees, they will observe agricultural practices in the United States.

The following alumni were elected members of the Honor Society of Phi Kappa Phi at a meeting held on January 20: Jose F. Zamora, '11, Eduardo A. Quisumbing, '18, Deogracias V. Villadolid, '19, Eulogio Rodriguez, Jr., '25, and Manuel B. Villano, '30.

Dr. Ivan E. Miles, former FOA fertilizer expert, wrote the Dean expressing his appreciation for the opportunity of knowing and working with a large number of people, including members of the College faculty. Doctor Miles has returned to his position at the Mississippi State College.

Prof. Harold E. Culver, geology consultant of FOA, Manila, and Prof. Jose M. Feliciano, head of the UP Department of Geology, were campus visitors on January 23, 1954.

Miss Filomena Fortich, agricultural botany instructor pursuing advanced studies at the University of Minnesota under Fulbright and Smith-Mundt scholarships, wrote the Dean about her ten-day tour of eleven eastern states. She was one of 83 university students, from various countries of the world, who joined the bus cavalcade.

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